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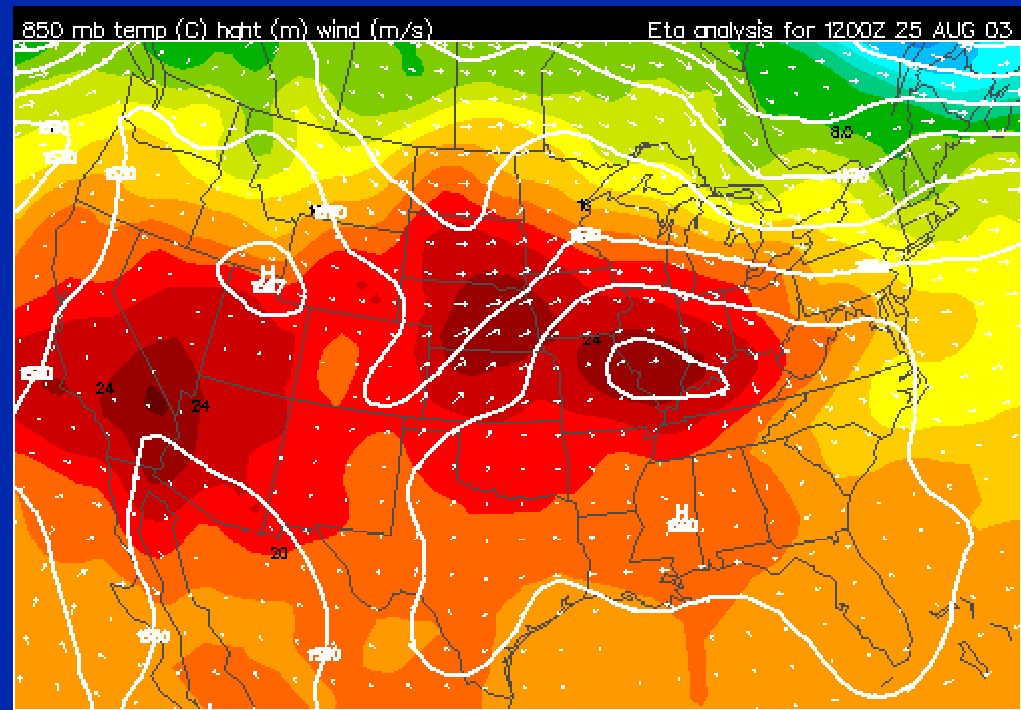
Case Study: Southeastern United States Ozone/PM_{2.5} Episode August 24-30, 2003

Lewis Weinstock

Forsyth County Environmental Affairs Department

Background

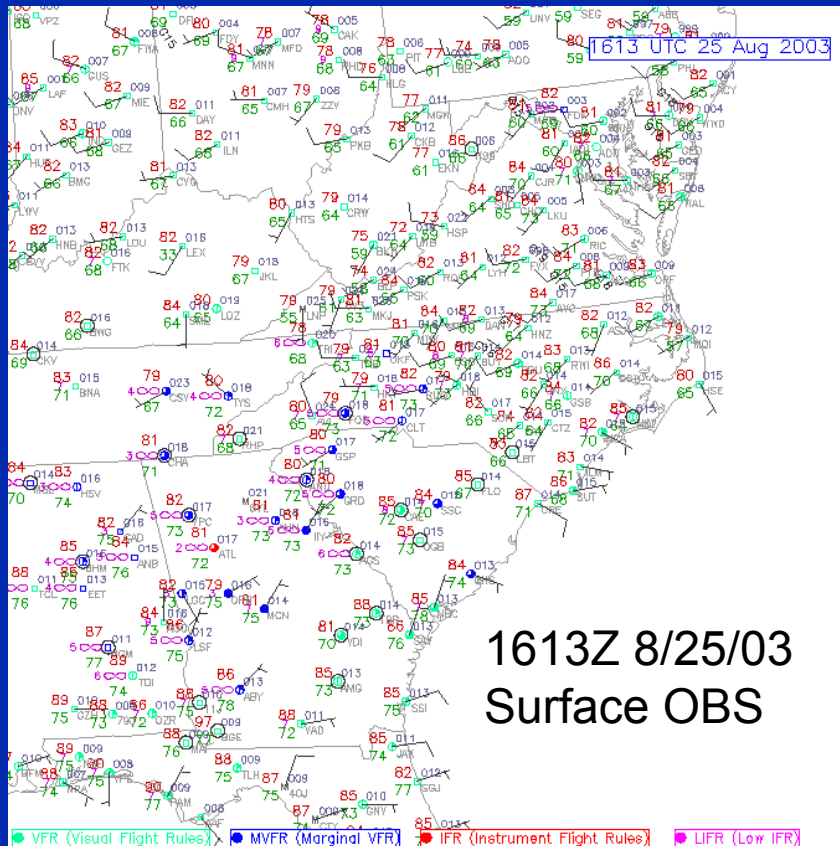
- Classic west-to-east ridge progression from August 24 to August 30, 2003
- Very warm 850-mb temperatures
- Short, recirculating trajectories
- Resulted in elevated ozone and PM_{2.5} levels



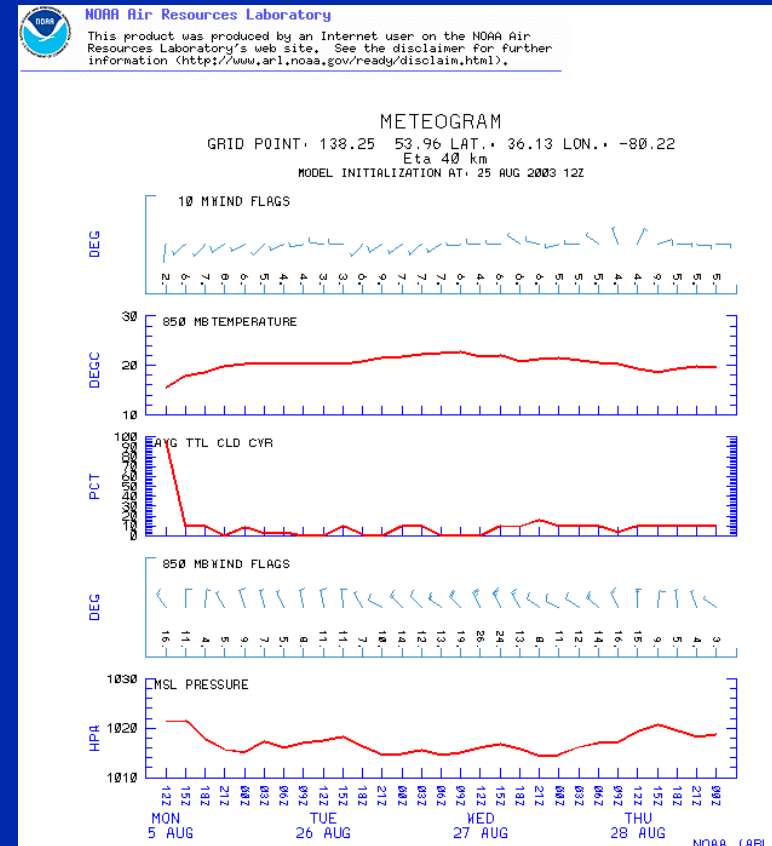
12Z 8/25/03 850-mb height, temperature, and winds
Image courtesy of Unisys weather

Side note - Case study benefited from MODIS data

Current and Forecast Data



Surface observations show haze reports across the Southeast United States (courtesy of Aviation Digital Data Service)



Eta model indicates clear skies, very warm air, and light winds (courtesy of NOAA ARL)

Key Forecast Decisions

- How high will AQI levels get?
 - Time to run those tools!
- Will this be an ozone- or $PM_{2.5}$ -dominated event (or both)?
 - What health advisory language should I use?
- What will finally break the episode?

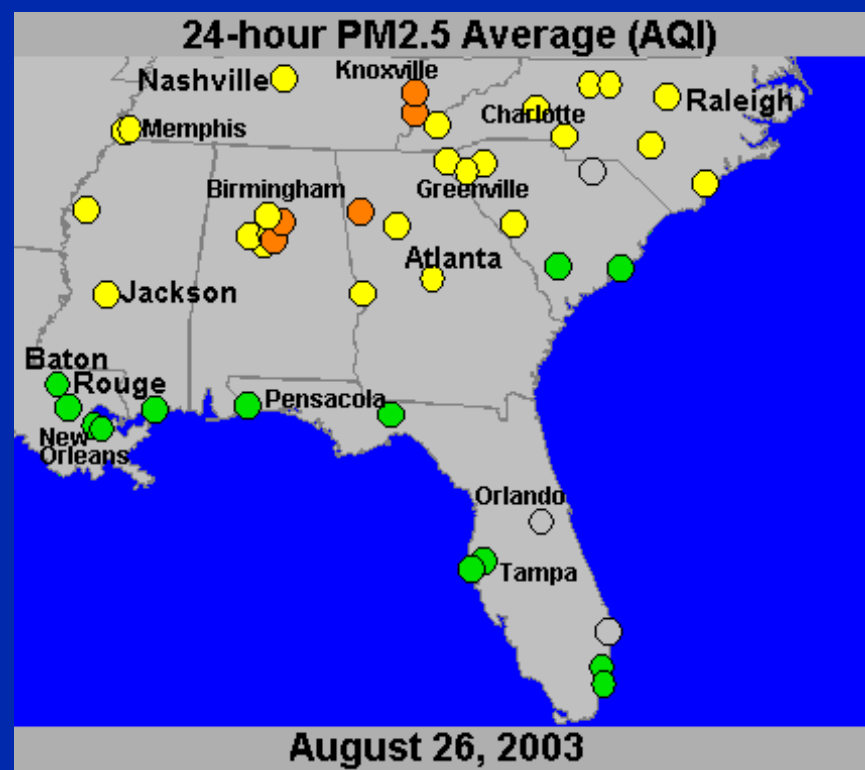
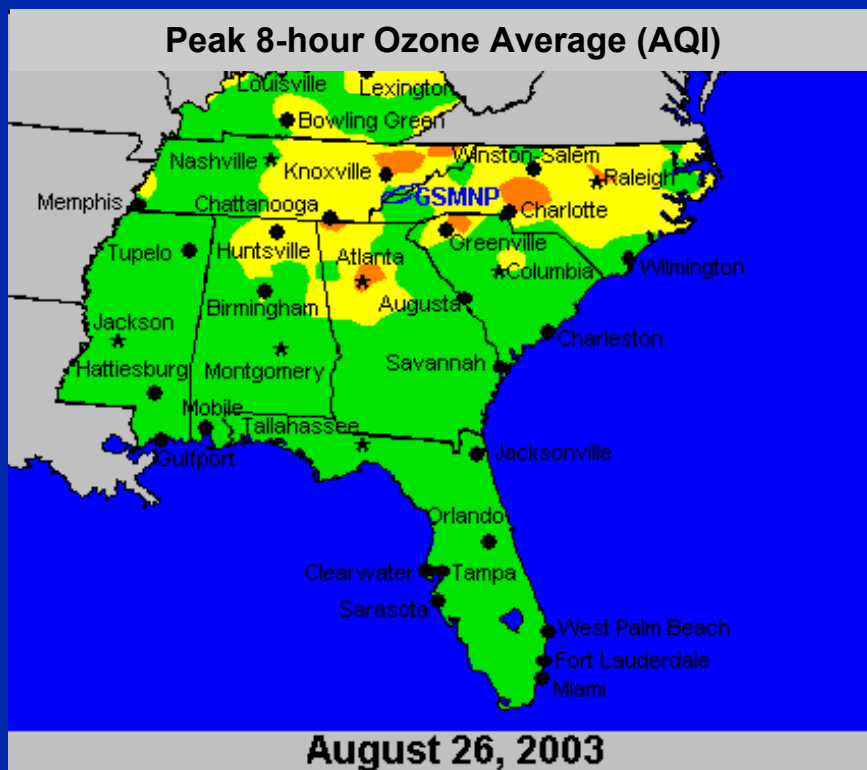


Charlotte Surface Observations

	8/24	8/25	8/26	8/27	8/28	8/29	8/30
T _{max} (°F)	85	86	90	92	91	90	90
Dew point (°F)	68	70	74	74	75	74	74
Wind speed (mph)	8	2	2	4	4	6	5

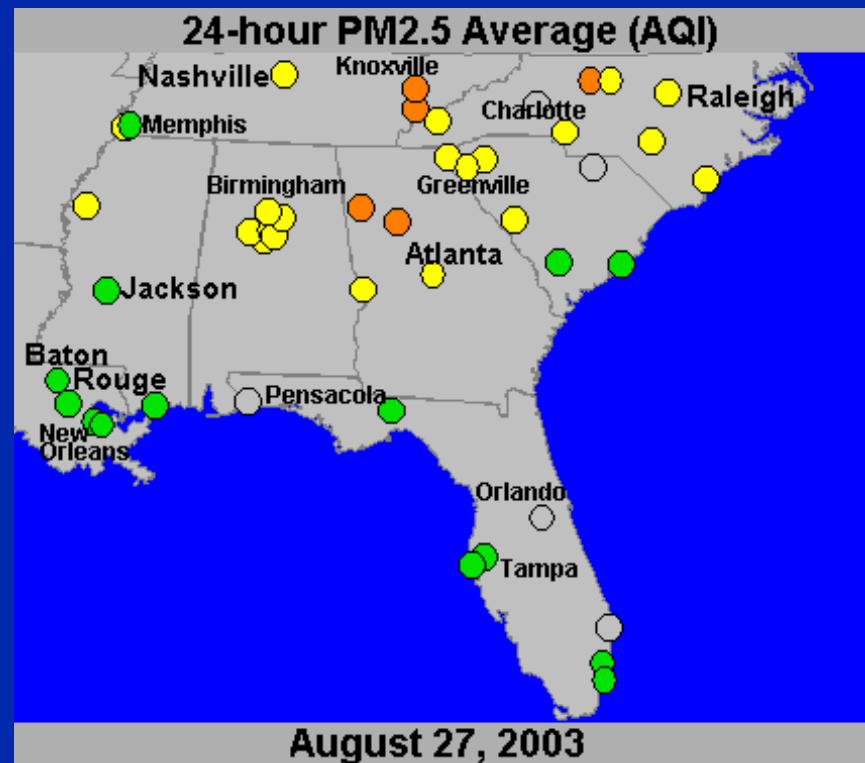
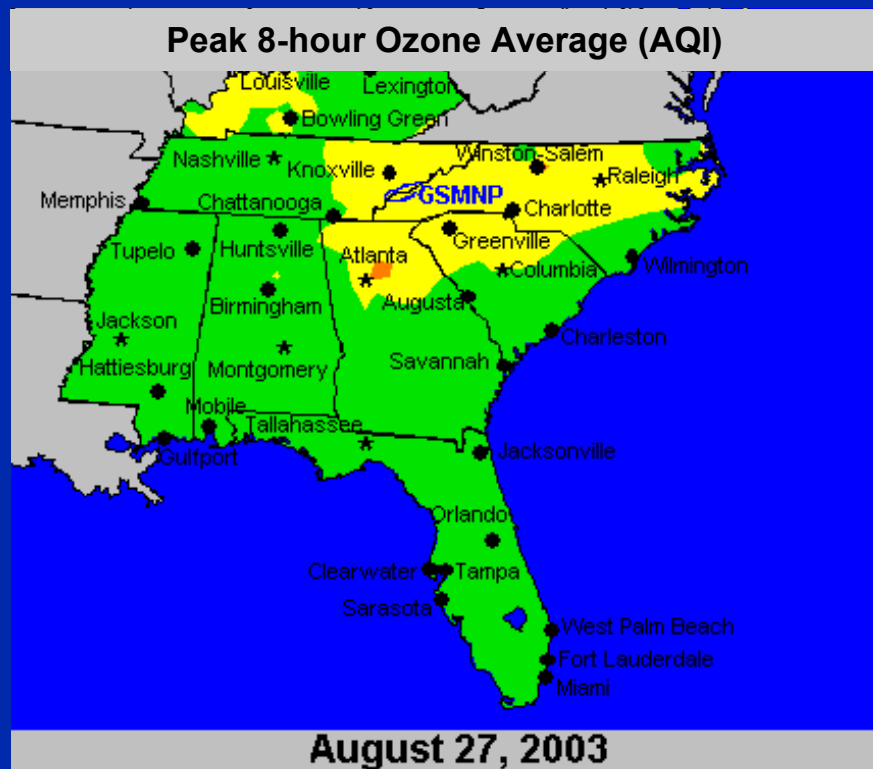
- Moisture is a key parameter that can affect ozone and PM differently. A stagnant, moist air mass can limit ozone production but encourage formation of key secondary fine PM-like sulfates and nitrates.
- Forecast tools will reflect difficulty in generating high ozone with dew points in the 70s.

Ozone versus PM_{2.5} AQI (1 of 3)



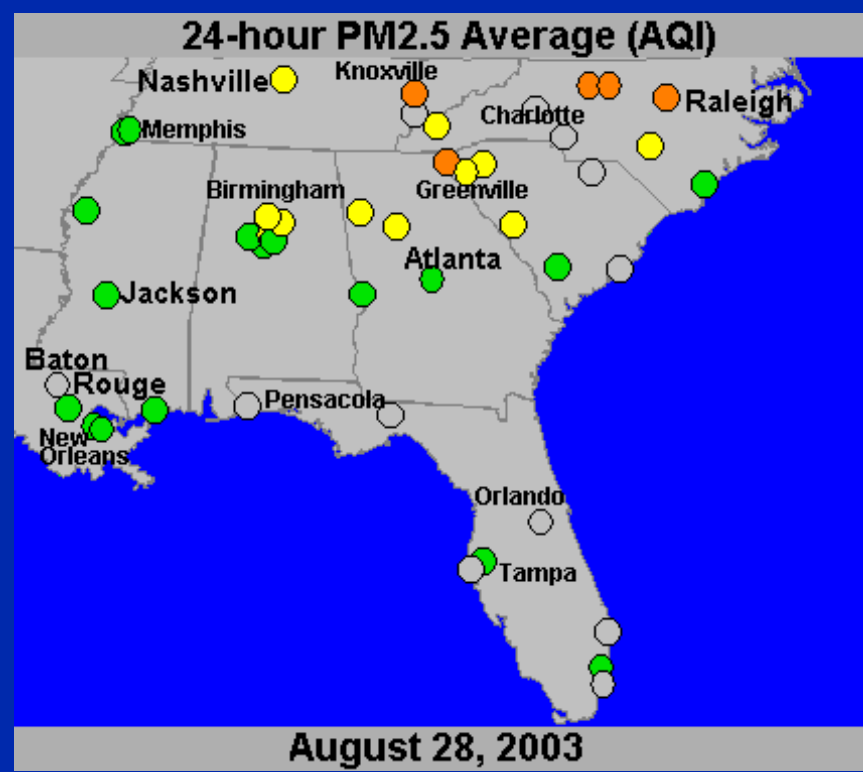
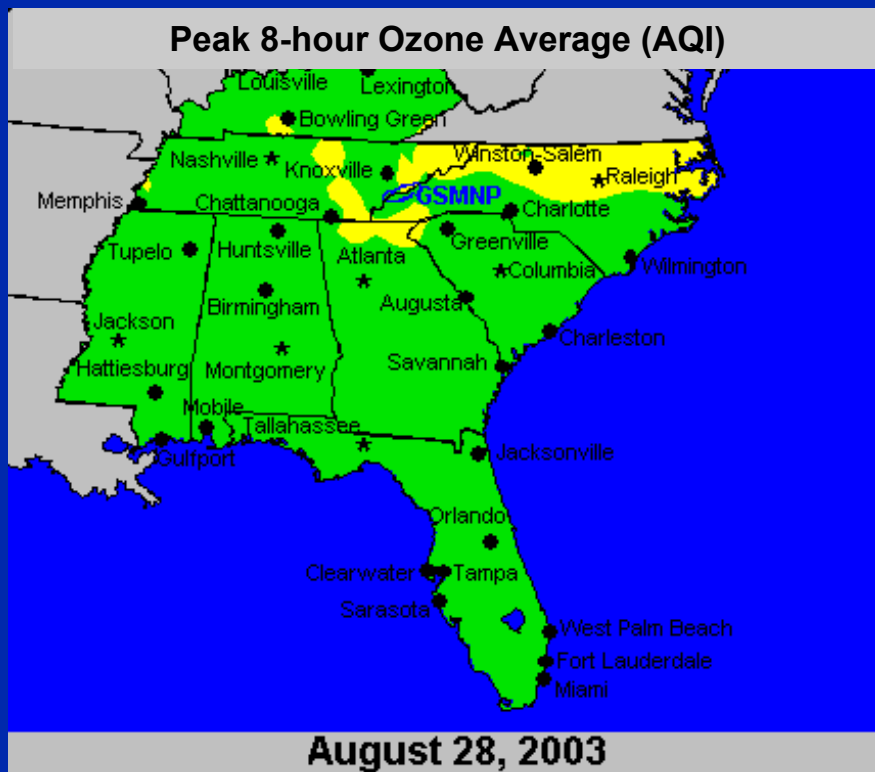
Ozone higher in North Carolina, PM_{2.5} higher in Alabama.
Similar response for both pollutants elsewhere.

Ozone versus PM_{2.5} AQI (2 of 3)



Spatial coverage of high PM_{2.5} exceeding ozone.

Ozone versus PM_{2.5} AQI (3 of 3)



PM_{2.5} dominates as ozone levels drop to Moderate AQI.
Highest PM_{2.5} AQI in Greensboro/Winston-Salem/High Point history.

Haze Cam View



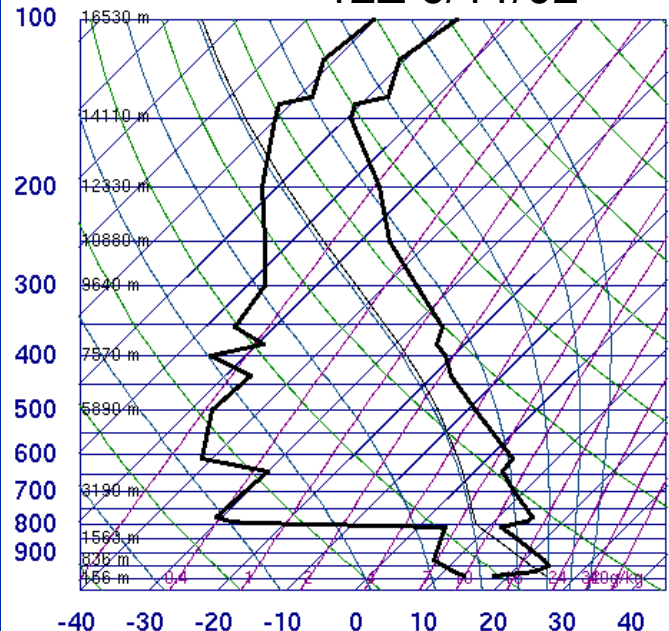
(<http://www.sehazecam.net/>)

1615Z 8/28/03

Upper-Air Soundings

Upper air soundings (skew-T format) for Greensboro, NC

72317 GSO Greensboro 12Z 6/11/02

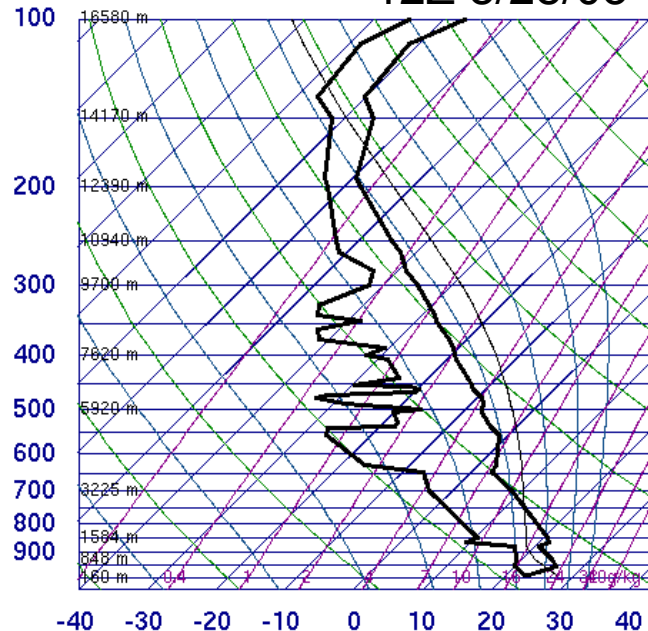


SLAT 36.08
SLON -79.9
SELV 270.0
SHOW 6.16
LIFT 5.28
LFTV 4.90
SWET 80.01
KINX -9.10
CTOT 13.90
VTOT 24.90
TOTL 38.80
CAPE 0.00
CAPV 0.00
CINS 0.00
CINV 0.00
EQLV -9999
EQTV -9999
LFCT -9999
LFCV -9999
BRCH 0.00
BRCV 0.00
LCLT 280.7
LCLP 796.3
MLTH 299.6
MLMR 8.33
THCK 5734
PWAT 14.52

12Z 11 Jun 2002

University of Wyoming

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SLAT 36.08
SLON -79.9
SELV 270.0
SHOW 0.70
LIFT -4.36
LFTV -5.02
SWET 173.0
KINX 26.70
CTOT 18.10
VTOT 28.10
TOTL 46.20
CAPE 1985.
CAPV 2194.
CINS -120.
CINV -78.2
EQLV 168.8
EQTV 168.6
LFCT 753.8
LFCV 789.0
BRCH 1239.
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LCLT 292.8
LCLP 903.0
MLTH 301.5
MLMR 16.34
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PWAT 36.37

12Z 28 Aug 2003

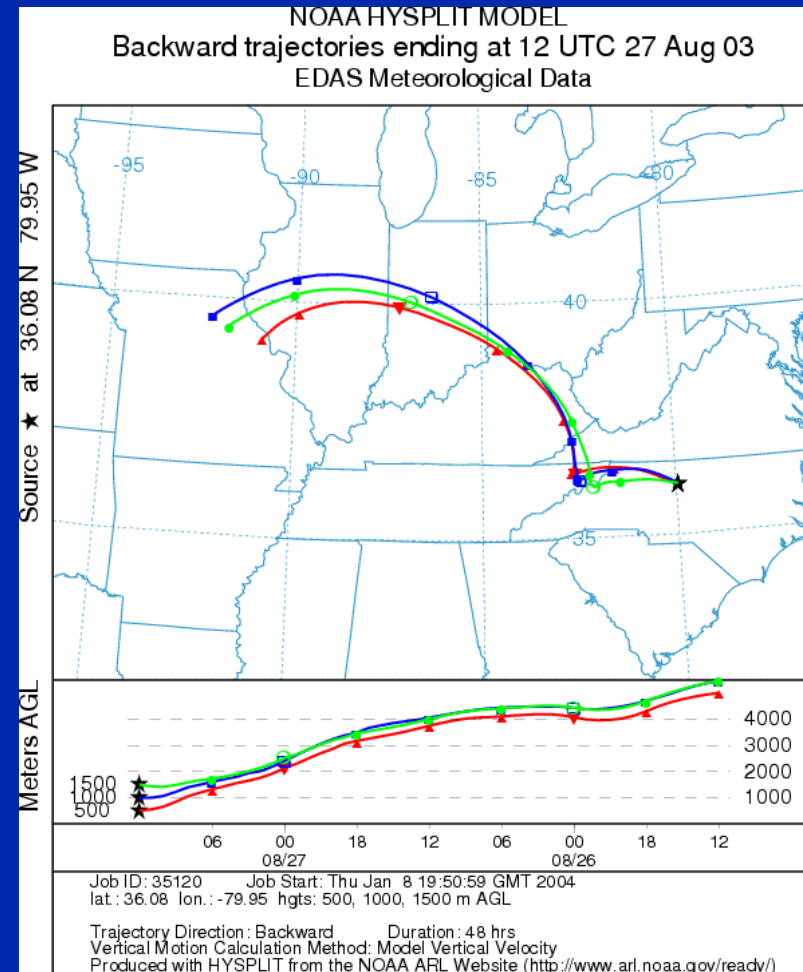
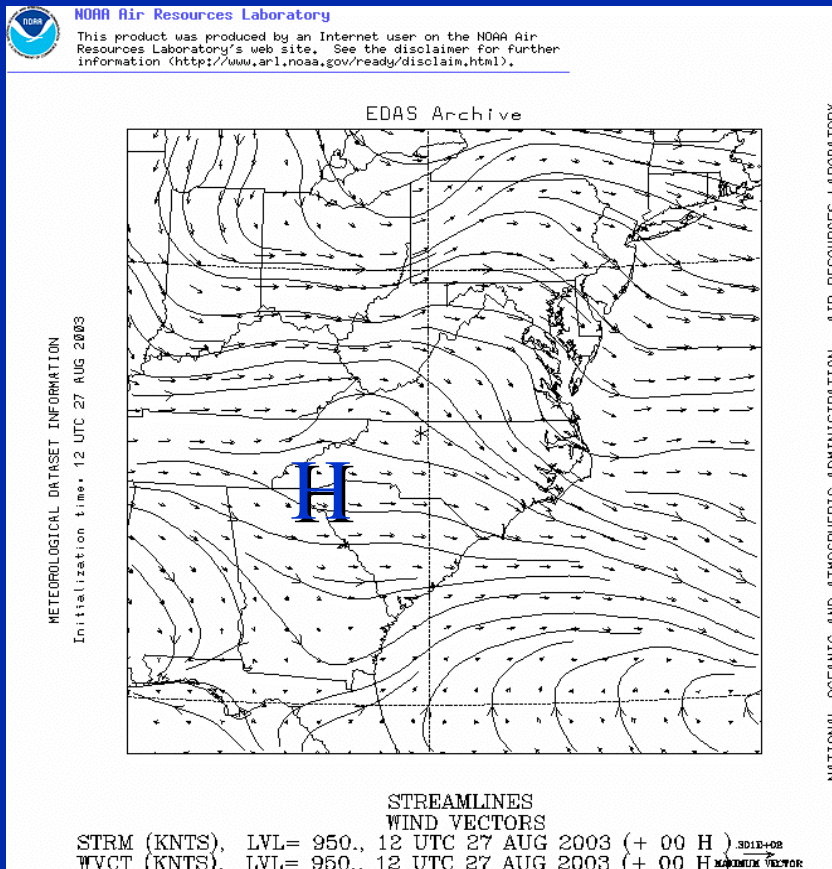
University of Wyoming

Unhealthy ozone and
Moderate PM_{2.5}.
Precipitable water = 14.52 mm.

USG PM_{2.5} and Moderate ozone.
Precipitable water = 36.37mm.

950-mb Winds and 48-Hr Back Trajectory (1 of 2) August 27, 2003

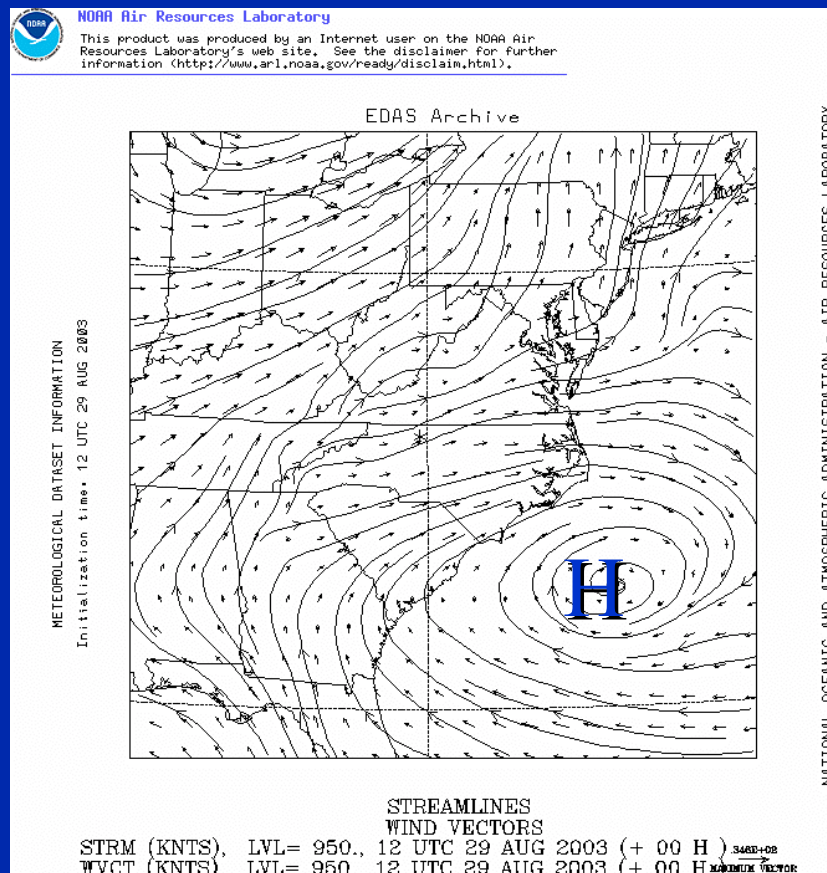
Images courtesy of NOAA ARL



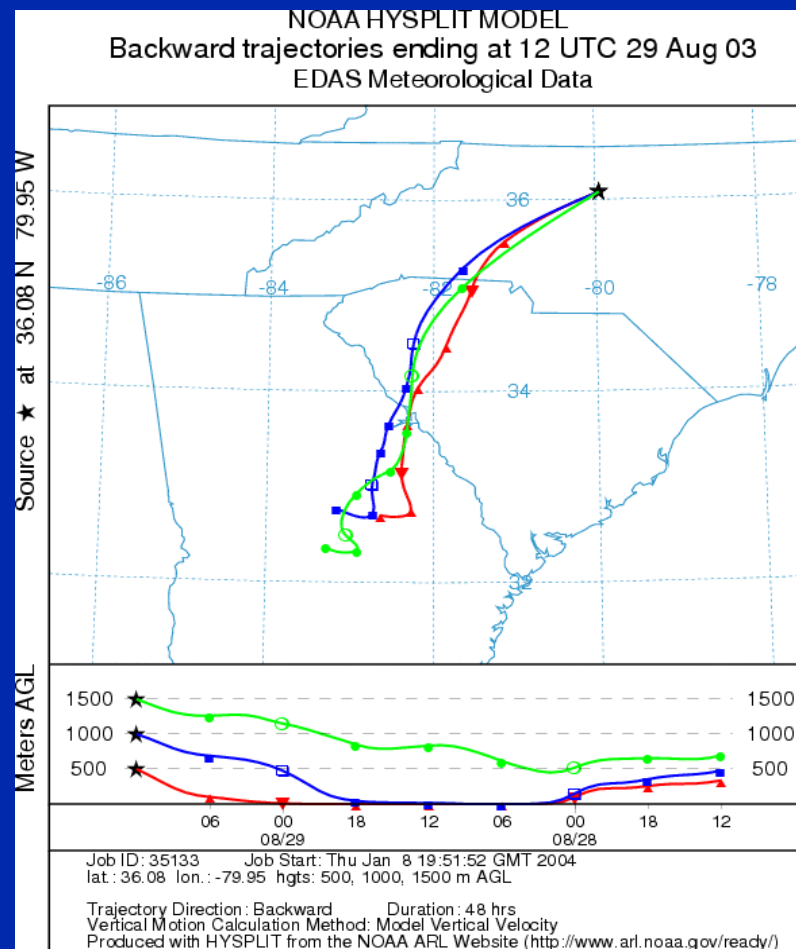
West/northwest flow from interior
of surface High – $\text{PM}_{2.5}$ is high.

950-mb Winds and 48-Hr Back Trajectory (2 of 2) August 29, 2003

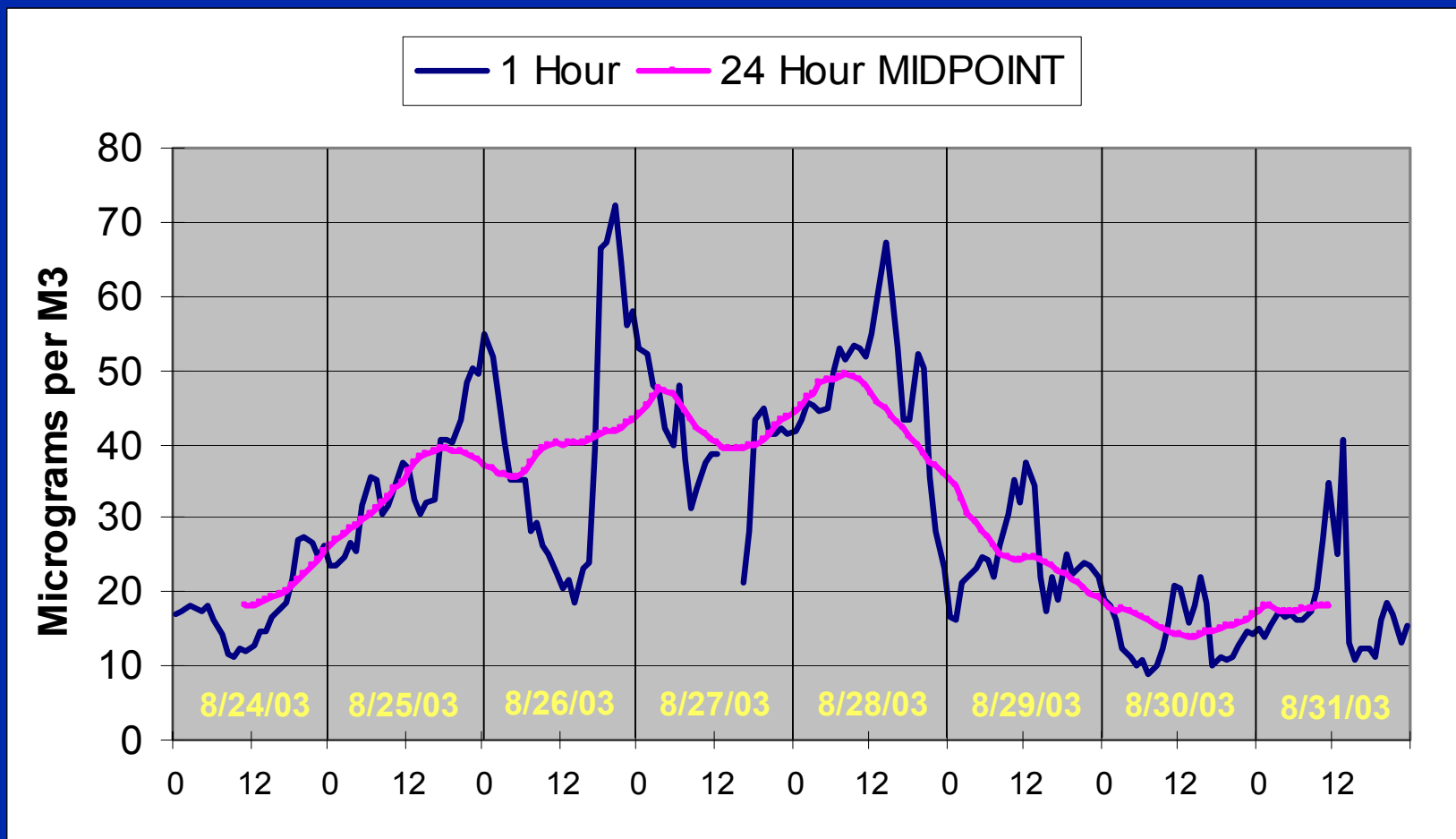
Images courtesy of NOAA ARL



Southwest flow with greater maritime component – $PM_{2.5}$ is lower.



PM_{2.5} Trend (Winston-Salem)



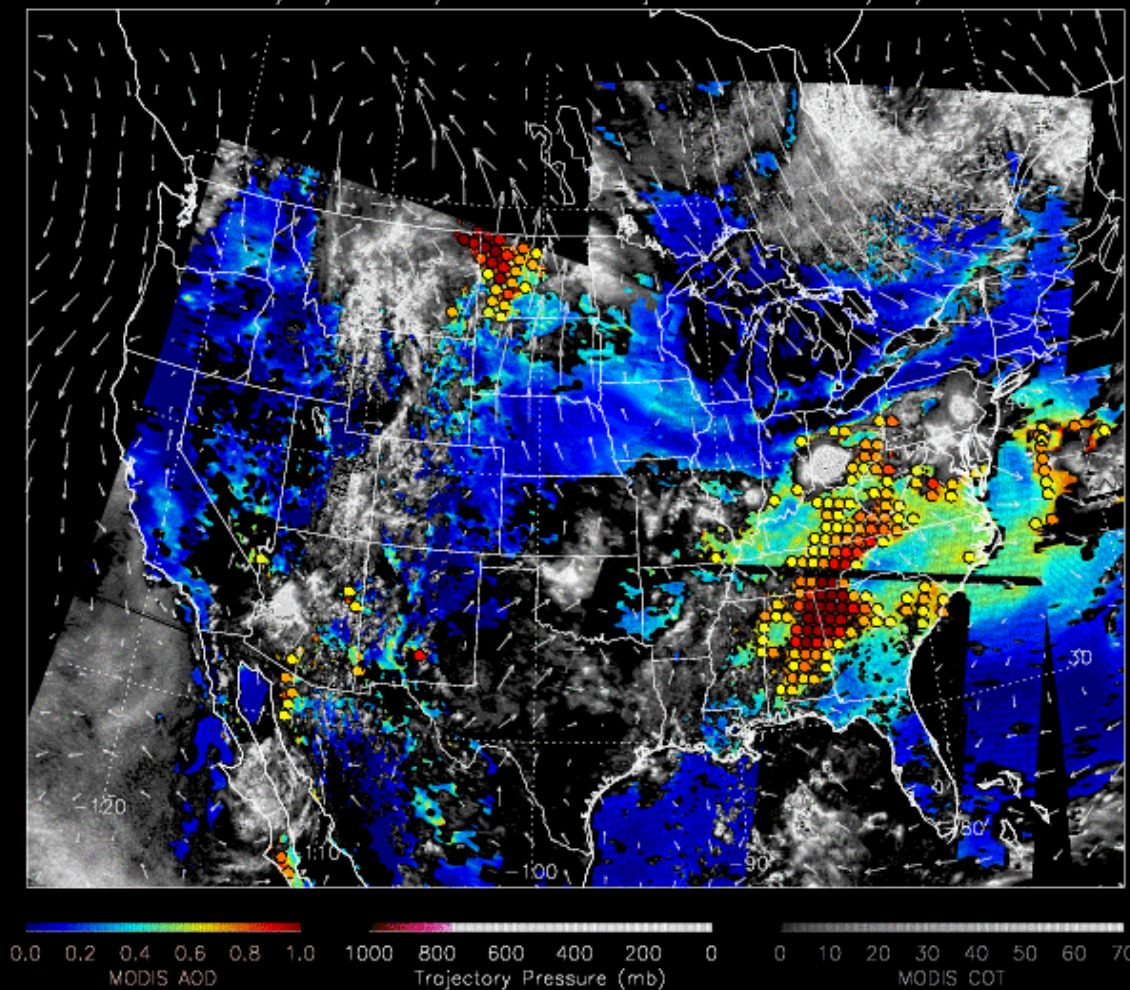
PM_{2.5} concentrations drop sharply late on August 28 in response to the influence of maritime/coastal air trajectory as high pressure drifts offshore.

Experimental Tools



MODIS AOD 8/27/03 & 48 Hr AOD Trajectories

MODIS 2003/08/27 AOD/COT & AOD Trajectories on 2003/08/27 14Z



<http://idea-aqi.larc.nasa.gov/index.php>



Late Summer Ozone/PM_{2.5} Episode Conclusions

- Ozone and PM_{2.5} can react differently to “favorable” stagnation conditions.
- Air-mass moisture can be a key factor in determining the likely “dominant” pollutant.
- Backward forecast trajectories show the shift in air parcel “origination” locations that can signal the end of an extended air quality episode.
- Satellite-based remote sensing methods show promise for anticipating the aerosol loading that occurs with air mass changes.